THURSDAY, DECEMBER 6, 1883

THE GEOLOGY OF THE LIBYAN DESERT

Beiträge zur Geologie und Palæontologie der Libyschen Wüste und der angrenzenden Gebiete von Ægypten, unter Mitwirking mehrerer Fachgenossen, herausgegeben von Karl A. Zittel. I Theil und II Abtheilung, 1 Heft. (Contributions to the Geology and Palæontology of the Libyan Desert and of the Neighbouring Districts of Egypt. By Karl A. Zittel, with the assistance of several scientific men. Part I. and Part II., Section 1.) (Cassel: Fischer, 1883.)

IN NATURE, vol. xxii. p. 587, there appeared a notice of the anniversary address for that year to the Academy of Natural Sciences in Munich delivered by Prof. Karl A. Zittel, the well-known Professor of Geology and Palæontology at the Munich University. The address contained a preliminary sketch of the work, the complete account of which occupies the quarto volume and portion of a second volume now before us.

In the winter of 1873-74 a scientific expedition under the leadership of Gerhard Rohlfs was despatched with aid from the late Khedive of Egypt, Ismail Pacha, to explore the Libyan desert or north-eastern portion of the Sahara. The scientific results of this expedition are now being published in a series of separate volumes, of which the Geology and Palæontology will form two. The first of these lies before us, the second is as yet incomplete, and only one section containing a description of the Eocene Echinoidea, by P. de Loriol, has hitherto appeared. The first volume comprises the geological description of the country by Prof. Zittel himself, an account of the fossil wood from the Nubian sandstone and from the well-known "fossil forest" near Cairo (Cretaceous), by Dr. A. Schenk; of the Miocene fauna of Egypt and the Libyan desert, by Dr. Th. Fuchs; of the Tertiary (Upper Eocene or Oligocene) fossils from the western island in the lake of Birket-el-Qurûn (about fifty miles south-west of Cairo), by Prof. Karl Meyer-Eymar; of the Foraminifera (the Nummulites excluded) from the Eocene beds of the Libyan desert and Egypt, by Conrad Schwager; a monograph of the Nummulites from the same areas, by the late Dr. Phil. de la Harpe; and a description of the Eocene corals, by Magister E. Pratz. These palæozoic descriptions are illustrated by thirty-six plates.

The remaining portions of the second volume will include an account of the Eocene Mollusca, by Prof. Meyer-Eymar; of the Cretaceous fauna, chiefly by Prof. Zittel himself; and of a few other subjects. Amongst the contributors, besides those already enumerated, the names of Prof. Beyrich, the Marquis de Saporta, Prof. Haushofer, and Prof. Zirkel are mentioned in the preface to the first volume.

An array of scientific names like the above, chosen from amongst the most eminent specialists of Germany, Switzerland, and France, proves that this is a work of more than ordinary geological importance. The principal author and editor, Prof. Zittel, is both a good geologist and a good palæontologist, a much rarer combination than is usually supposed.

On the geological map in the first volume an area occupying rather more than 5° of latitude (25° to 30° N.) and above 8° of longitude (about 25° 30′ to 33° 40′ E.) is coloured. This country includes the Nile valley from Cairo to Edfu (the geology of the valley itself is shown as far south as Assuan), and extends eastwards to the shores of the Red Sea, and westward far into the great desert tract of Northern Africa. The whole area coloured geologically may be roughly estimated at between 150,000 and 160,000 English square miles.

It will easily be understood that the mapping is of a very rough description, a geological sketch in fact, but in desert countries, owing to the want of vegetation to conceal the rocks, and to the clearness of the atmosphere, it is remarkable with what accuracy geological formations can be traced by the eye to great distances. A considerable proportion of the area is coloured from the observations of other travellers, and especially of Schweinfurth. The routes of the expedition under Rohlfs and of other travellers are marked on the map, and show how much of the area has actually been examined.

Among the numerous points of interest presented by the volume it is difficult to select any one as superior to the others. In the former notice in NATURE the general characters of the geological systems observed (Cretaceous, Eocene, Miocene, and the so-called Quaternary and recent) were briefly described. To enter at any length into a notice of the palæontology would take too long. At the present time when the writings of F. von Richthofen and others have called especial attention to the subaërial or Eolian formations of the latest geological times and the present day, the description of the surface phenomena presented by the desert tracts of the Sahara, coming from so keen an observer as Prof. Zittel, are well worthy of attention, and a few remarks upon them may prove interesting.

The geological portion of the work is divided into two chapters: the first, containing forty-two pages, being devoted to the Sahara as a whole; the second to the geology of the Libyan desert and Egypt. In both of these chapters considerable space is devoted to the superficial characters of the desert. The surface of the Sahara is divided by Prof. Zittel, according to its characters, into four kinds:—(1) Plateau-desert or Hammâda, occupying the largest portion of the area, a level, hard, stony surface in general, without noteworthy elevations or depressions, but passing locally into (2) mountainous desert. The so-called (3) erosion-desert consists of depressions more or less occupied by salt-marsh. The last form of surface, the most remarkable and interesting of all, is the (4) sandy desert or Areg, composed of drift sand forming hills or downs (dunes).

Prof. Zittel shows, on what appears to be an overwhelming amount of evidence, that the popular idea of the Sahara having been the basin of a sea in Pleistocene times is without foundation. The greater part of the area has apparently been above water ever since the Cretaceous epoch; a comparatively small tract in the north-eastern portion was submerged beneath a Tertiary sea, whilst the only part that can have been under water in post-Tertiary times consists of a tract extending from the Nile delta to the oasis of Ammon, and to the so-called "Chotts" of Tunis, and even in this tract marine conditions in late

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geological times are doubtful. But Prof. Zittel considers that the climate must have been damper, the rainfall heavier, and freshwater denudation more active in Pleistocene days than now, to account for the erosion that has taken place, the abundance of fulgurites, and the present distribution of the fauna and flora, especially in such cases as the occurrence of Central African crocodiles in the marshes and streams of the completely isolated Ahaggar Mountains. Reasons are also given for believing that the Nile was formerly a larger river than it now is. It is probable that Prof. Zittel's views on some of these points will be contested, but it is impossible to deny that his arguments are admirably expressed and clearly reasoned out.

Some very interesting details are given about the desert sand, and a careful description of its arrangement in the form of sandhills. The sand of the Sahara is considered to have been largely derived from the decomposition of the so-called Nubian sandstone, the original matrix of the well-known silicified wood. In the Libyan desert there are some remarkable anomalies in the arrangement of the sandhills, and it is clear that they cannot have been entirely formed by accumulation through the agency of the prevailing wind as it exists at the present day. It may here be remarked that very similar observations were made, a few years since, upon the sand ridges of the Indian desert east of the Indus. Some of the sand ridges, both in Africa and India, attain an elevation of about 500 feet, and in both areas the largest appear to have undergone no change within the memory of man, although in places, in both continents, moving tracts of sand occasionally overwhelm cultivated land and buildings.

One mistake in the book deserves notice. In the comparative table of Upper Cretaceous and Eocene beds in Europe, Asia, North Africa, and North America the position assigned to some of the Tertiary stages of the Indian rocks requires correction. The lower Nari beds in especial were never supposed to be so old as Middle Eocene (Parisian), and they are now known to be in all probability true Oligocene. But trifling mistakes of this kind are to be expected: it is surprising that more should not have been observed.

W. T. B.

APPLIED MECHANICS

Applied Mechanics. By H. T. Bovey, M.A., Professor of Civil Engineering and Applied Mechanics, McGill University, Montreal, Fellow of Queen's College, Cambridge. Part I., pp. 190. Part II, pp. 150. (Montreal: J. Lovell and Son, 1883.)

THIS work appears to be designed as a college text-book for somewhat advanced students, who have already received good training in mathematics (as far as the elementary parts of the integral calculus) and theoretical mechanics.

Part I. treats of the strength of materials, dealing with longitudinal stress, the strength of beams and pillars, torsion, and the strength of hollow cylinders and spheres.

In Part II. we have chapters on frames, roofs, bridge-trusses, suspension bridges, arched ribs, and in conclusion one on "details of construction," which includes a discussion of the strength of rivets and other fastenings.

In his exposition of these subjects the author manifests a power of clear and precise statement; and the treatment of the more difficult problems of the first part is perhaps as profound as could be attained without a knowledge of the general theory of elasticity. The numerous illustrations serve sufficiently well in Part I., where they consist chiefly of diagrams; but in Part II. they are on too small a scale for the complicated structures illustrated: and in clearness of detail are far below the standard reached in recent English books on the same subjects. Analytical methods are preferred throughout; and generally speaking geometry is used merely to illustrate results previously obtained in a symbolical form. Thus graphical statics is quite subordinate in Part II.; stress diagrams are introduced, but there are not sufficient instructions in the text to enable a student, who has not studied the subject independently, to construct them for himself.

In the extended treatment of a parabolic rib of uniform stiffness (pp. 101-120) the author follows very closely the lines in Rankine's "Civil Engineering," with some further consideration of the additional terms depending on change of temperature.

There is no acknowledgment in regard to this and other parts of the work where Rankine's influence is clearly apparent. But as no preface is given to the present volume, perhaps other portions of the great subject of applied mechanics are in course of preparation by our author; and till the completion of his work he is postponing the statement of his obligations to those who have gone over the ground before.

We have referred to the apparent excess of symbolical reasoning: but none of this is due to the introduction of investigations better left to treatises on pure mathematics and theoretical mechanics.

Difficulties special to the subject of the work, such as the equations of the "neutral axis" (so-called) for all the different modes of loading and supporting a beam, the theorem of three moments, the moments of inertia of complicated forms of section, the deflection of struts, are however treated with the fullness of detail required by ordinary students.

Such investigations constitute the best feature of the book. The detailed application to problems such as occur in actual practice is but slightly touched on; perhaps for this we are to look to the "Examples," of which some few are worked out in the text; appended to the several chapters, moreover, are close upon 400 proposed for the exercise of the student.

These form a very important collection. A great number involve numerical results, and unfortunately the answers are not given; this greatly lessens their value for private students at any rate. Several examples are taken from existing structures, and are liberally furnished with diagrams in illustration of the data.

Many are new to text-books, and the author has evidently taken great pains in collecting and arranging them.

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